

and his paper on the possibility of obtaining interference between light from different sources had to be taken as read. Dr. Stoney believes he has obtained undoubted experimental proof of the possibility, but the matter must be held over till his proof can be considered and discussed.

Prof. Schuster gave an account of his experiments on the passage of electricity through mercury vapour. They seem to indicate that pure mercury vapour is a non-conductor.

Prof. Minchin described the latest form of his photo-electric cell, which consists of two selenium coated aluminium wires dipping into certain solutions, and produces a measurable E.M.F. when one wire is exposed to the light of a star. An arrangement so sensitive should have a great future before it.

In the meteorological department of the Section, papers by Messrs. W. N. Shaw and R. W. Cohen, on the effects of sea temperature and wind direction on the seasonal variation of air temperature in these islands, were read. The presence of the sea delays each seasonal change of temperature, and the authors are investigating the effect of the direction and temperature of the prevailing winds on the air temperature at the four principal stations of the Meteorological Office. Mr. F. N. Denison has found that the depression of the earth's crust due to an area of high barometric pressure can be detected by a seismograph at great distances from the centre of the depression, the instrument being tilted towards the area of high and from that of low pressure. The approach of a barometric depression is therefore indicated by the seismograph long before the barometer shows any sign of it.

In the mathematical department, Prof. Mittag-Leffler communicated a paper on a criterion for recognising the irregular points of analytic functions, an important extension of the theory of convergent series of powers to convergent series of functions. Mr. R. W. H. T. Hudson extended the idea of Newton's diagrams to the theory of differential equations. Prof. G. H. Darwin communicated a paper on Poincaré's pear-shaped figure of equilibrium of a rotating liquid, and Col. Cunningham announced the discovery of certain high primes, mainly by the use of the numbers called by Euler "idoneal." Several new theorems dealing with idoneal numbers were announced by Col. Cunningham and the Rev. J. Cullen. Further papers dealt with modified proofs of propositions already known.

In the astronomical department, Prof. Turner in his opening address called attention to the need of cooperation in astronomical work, cooperation which should not sink the individuality of the observer, or substitute routine for an alert spirit of inquiry and investigation. Prof. G. Forbes brought forward several facts which seemed to support his contention that there is a planet beyond Neptune with a mass about equal to that of Jupiter. Father Cortie announced that he had found the faculae on the sun's surface followed the same law of rotation as the spots, and Mr. Hinks showed that the objections which had been raised to the determinations of the solar parallax from photographs of Eros, on the ground that it was a moving object, were unfounded. At the close of the sitting, Prof. Turner announced that Prof. Pickering had succeeded in taking a photograph of the spectrum of a lightning flash, and that important information would be forthcoming when the photograph had been measured.

C. H. LEES.

ZOOLOGY AT THE BRITISH ASSOCIATION.

THURSDAY, September 12.—The president's address was taken later than usual in order to afford opportunity of attending some other sectional address. In the afternoon the reports of committees and a few papers were taken, as follows:—

(1) Dr. Hepburn and Dr. D. Waterston gave a paper on the pelvic cavity of the porpoise as a guide to the determination of the sacral region in Cetacea. The chevron bones distinguish the caudal vertebrae in cetaceans, but there is no easy method of distinguishing sacral from lumbar vertebrae. The authors find a true pelvic cavity in the porpoise which corresponds to five pre-caudal vertebrae, and they suggest that these five vertebrae are to be regarded as sacral in Cetacea. They find considerable variation in the position of this sacral region in the different Cetacea, which they consider to be due to differences in the numbers of dorsal and lumbar vertebrae present.

(2) Prof. R. J. Anderson, on the relationships of the premaxilla in the bears. The premaxilla differs in the level and breadth of

its articulation with the frontal, just as the nasals reach higher up and further back in some bears than in others. Genera allied to the bears approach them in regard to the relation of the premaxilla to the frontal, so do some of the Canidae, but to a less degree, whilst other forms of the latter family have a wide interval between the premaxillae and frontals. It is not difficult to account for the enlarged premaxillae of elephants, whales and rodents, or for the short stout forms in Suidae, &c.; but the seals, while in some respects resembling the arctoids, differ much in their premaxillae. The isolated centres met with in some animals in the frontal region (e.g., *Gorilla*, *Ursus*, *Labistus*) are wormian. The separate bone found in connection with the ventral part of the premaxilla in monotremes is not found in other mammals.

(3) Reports of Committees:—"On bird migration in Great Britain and Ireland."—The committee expresses its most grateful admiration of Mr. Eagle Clarke's invaluable services. Mr. Eagle Clarke supplies detailed statements on the migrations of the skylark and of the swallow, those of the former being of an extremely complicated nature.

"Index Animalium."—During the last year the period 1758–1800 has been dealt with. Arrangements had been made with the Cambridge University Press to begin the work of printing this first part of the Index in May, 1901. The indexing of 1801–1900 now continues. The whole of the work, as usual, has been done by Mr. C. Davies Sherborn.

Zoology of the Sandwich Islands.—This eleventh report states that Mr. R. C. L. Perkins has been working during the last year almost solely on the island of Oahu. The present position of the work is discussed.

Coral Reefs of the Indian Regions.—Mr. J. Stanley Gardiner has sorted out the marine collections from the Maldivé and Laccadive archipelagoes into groups for the specialists, and some of these groups have already been worked up. The collections seem very complete, and the committee asks for assistance in publishing.

Table at the Naples Zoological Station.—In addition to the usual statistical information the committee give reports from Dr. Reginald Buller on the fertilisation process in Echinoidea, and from Dr. Hamlyn-Harris on the statocysts of Cephalopoda.

Table at the Plymouth Marine Laboratory.—The occupation of the table during the year is reported on.

Natural History and Ethnography of the Malay Peninsula.—Mr. W. W. Skeat gives an account (to Sections D, H and K) of the Cambridge Exploring Expedition. An extensive collection of vertebrates was made, and the first two species of *Peripatus* found in the Malay peninsula were discovered. These latter have recently been described by Mr. R. Evans.

Plankton Investigation.—Mr. Garstang reports upon his periodic work in the English Channel.

On September 13 the following papers were taken:—

(1) Mr. J. Stanley Gardiner, on the coral islands of the Maldives.—The Maldivé group to the south-west of Ceylon is made up of a large series of comparatively shallow banks, separated from one another by channels of about 170 fathoms in depth. They extend north and south as a chain, double in the centre, for 550 miles. All are covered with coral reefs, arising to the surface. Some banks have on their circumferences the single ring-shaped reefs of perfect atolls, while others are studded with numbers of small isolated reefs, many of which are of circular form with shallow lagoons (atollons). The two classes of bank merge into one another, and the changes, going on at the present day, are such that the atolls may be supposed to have arisen by the fusion of the smaller reefs. All land in the group owes its origin directly or indirectly to elevation, and in most atolls is very markedly washing away. Everything points to a state of rest at the present day. The atoll reefs are perfecting themselves on all sides, and passages are closing up. The reefs, however, are not broadening, but to a certain point narrow as they become more perfect. The central basins of atollons are everywhere coming into free communication with the lagoons of the atolls. There is no trace of the filling in of the latter; indeed, such evidence as was found pointed, on the contrary, to their further widening and deepening and to the gradual destruction of the shoals and lands within the encircling reefs. The Maldivé group marks the existence of an ancient land-area, but the changes going on are not consistent with the view that the reefs were formed on the subsidence of the land. The various reefs appear rather to have grown up separately on slight elevations of a common plateau at a depth of 150 fathoms,

while the plateau itself seems to have been formed by the washing away of the original land by wave and current actions.

(2) Mr. E. J. Bles, on a method for recording local faunas. Mr. Bles urges the use of uniform slips as in a library card catalogue, each slip to contain name of species, locality, date of capture, &c. The advantages of cooperation should be combined with this coordination of the recorders.

(3) Prof. J. Arthur Thomson's germinal selection in relation to inheritance was an attempt to test the utility of Weismann's subtle theory as a provisional interpretation of some of the important facts of inheritance. After inserting "a struggle of gametes and potential gametes" between the "histonal" or intra-organismal selection of Roux and the "germinal selection" of Weismann, he sought to extend Weismann's conception, pointing out that within the germ there might be three forms of struggle: (a) between determinants of the same character; (b) between determinants of quite different kinds; and (c) between the determinants and their somatic or more external environment. But the bulk of the paper was devoted to testing the theory as a unifying interpretation of otherwise unrelated facts of inheritance.

(4) Prof. Thomson also gave some notes on the behaviour of young gulls artificially and naturally hatched. After describing the actions of the young *Larus ridibundus* in the first three days after hatching, he noted that the young birds never ate deleterious or useless substances; that it took them a relatively long time to learn to recognise water in a shallow dish, though they drank with avidity when plunged into water or when they got their bills wet by pecking at their feet or at particles while standing in the water; that swimming and preening movements were seen in great perfection as early as the third day; and that the "kin-instinct" seemed very strong.

In the afternoon there were two papers by Mr. W. S. Bruce, on the fishes of the Coats' Arctic Expedition and preliminary notice of the fauna of Franz Josef Land, a paper by Dr. T. H. Bryce on heterotypical division in the maturation of the sexual cells, and a demonstration by Prof. Marcus Hartog and Mr. Nevil Maskelyne on the mechanism of the frog's tongue, showing the method of protrusion by means of a model.

On Saturday, September 14, the Section did not meet, but a number of the biologists took part in a very pleasant and successful expedition in connection with the Millport Marine Station. The party, on board the steamer *Ivanhoe*, accompanied the steam-yacht *Mermaid*, belonging to the station, on a dredging and trawling excursion round the shores of Cumbrae. In the afternoon the party landed and inspected the Marine Station, including aquaria, laboratory and the "Robertson" Museum. Copies of a special handbook issued by the Marine Biological Association of the West of Scotland, and compiled by the hon. sec., Mr. J. A. Todd, were supplied to the visitors. This gives an interesting account of the history of the Marine Station, and of the successive benefactions—Sir John Murray's "Ark," the "David Robertson" Museum, the present building, due largely to the liberality of Dr. Thomas Reid, the steam-yacht *Mermaid*, and other gifts from an anonymous donor—crowned, we believe, by an additional 3500*l.* given since this excursion to provide an extension of the building.

On September 16 the following papers were laid before the Section:—(1) Mr. J. J. Lister, on dimorphism in Foraminifera, with lantern illustrations. This subject was exemplified by the life-history of *Polystomella crispa*, in which two forms occur, the microspheric and the megalospheric, differing from one another in the size of the central chambers, the character of the nuclei and in relative frequency. The transition from the microspheric to the megalospheric form was traced by a series of photographs of an individual of the microspheric form, the protoplasm of which emerged from the shell and broke up into a brood of megalospheric young. These having reached maturity give rise in turn to actively motile zoospores. It was shown that the facts of the life-history are inconsistent with the view that the two forms represent the two sexes, but confirm that which regards them as alternating or recurring forms in a cycle of generations. While the megalospheric form arises asexually, there are considerable grounds for supposing that the microspheric form is produced by the conjugation of zoospores.

(2) Dr. J. Y. Simpson, on the relation of binary fission and conjugation to variation. The species specially examined were *Paramecium caudatum* and *Styloniichia pustulata*, and examination was restricted to (a) general outline, (b) total length,

(c) extreme width, (d) distance between contractile vacuoles, (e) length of middle caudal bristle. In all five points variation was found. This was illustrated by microphotography. The author contends that there is variation in binary fission, and that the process is not merely one of duplication.

(3) Mr. W. E. Hoyle, on a new form of luminous organ, intrapallial, in Cephalopoda.

(4) Mr. R. Shelford, on the habits and life-histories of some Sarawak insects, illustrated by the lantern.

(5) Prof. J. C. Ewart gave a lantern demonstration on zebras and zebra hybrids. This was illustrated by an exhibition of three of the actual hybrids in the medical quadrangle (see description below).

(6) Dr. J. F. Gemmill, on a large nematode parasitic in the sea-urchin. This worm, which the author proposes to call *Echinonema grayi*, occurs in the perivisceral cavity, and seems to have escaped notice except for a brief mention by A. E. Shipley in 1900. The females are 60 to 150 cms. in length, and the males only 5 to 10 cms. An account of the anatomy was given.

(7) Mr. F. H. Marshall gave exhibitions of abnormal specimens of *Nephrops*, and of microscopic preparations of mammalian hairs.

Some of the members of the Section took part on the Monday forenoon in a conference between Sections C, D and E on the subject of limnology, with special relation to the scientific study of the lakes of the British Islands. It was announced that Sir John Murray and Mr. Lawrence Pullar had undertaken to defray the expenses of a survey to be undertaken by three scientific men during five years, and the conference discussed the best methods of carrying out the proposed scheme from the points of view of the different sciences involved.

On September 17, four papers were taken in the morning:—

(1) Mr. C. Forster Cooper, on the fauna of an atoll, with lantern illustrations.

(2) Mr. L. A. Borradaile, on the land crustaceans of a coral island. The author pointed out the importance of land crustaceans in the economy of tropical nature in general, and of a coral island in particular. He then enumerated the species he had observed in the island of Minikoi in the Indian Ocean with an account of their appearance and habits. Special emphasis was laid on the interesting land hermit-crabs of the genus *Coenobita*.

(3) Mr. J. S. Budgett, on the youngest known larva of *Polypterus*, with lantern illustrations. From his observations on the structure of the pectoral fin, the primordial cranium and the visceral arches of this larva, obtained in the Gambia in 1900, the author believed that the Crossopterygii showed affinities with the Selachii, but that the structure and development of the urino-genital organs, though in both probably of a very primitive nature, disclosed teleostean affinities, while the structure of the osseous skeleton has in many points been shown to resemble that of the Stegocephali and Amphibians. He therefore concluded that the Crossopterygii were a central group retaining relations with most of the great groups of Ichthyopsida, but not being actually ancestral to any one of them.

(4) Mr. J. Graham Kerr, on the origin of the vertebrate limbs. The author gave a short account of his hypothesis of the homodynamy of the vertebrate paired limbs with the true external gills. After pointing out the absence of solid foundation in fact for the two most widely accepted hypotheses of the origin of the paired fins, and having criticised these two views generally, he accentuated the probability that the two main types of limb, Ichthyopterygium (including Archipterygium) and Cheiropterygium, were derived independently from a simple styliform projection of the body (Stylopterygium), which was used, not for swimming, but for clambering about a solid substratum. This, from the evidence of Braus and others, was probably somewhere about the hind end of the branchial region. Now were there any projections from the body in this region from which the motor stylopterygium could have become evolved? Mr. Kerr pointed out that in the true external gills there existed a series of organs, projecting in various groups of lower vertebrates from the visceral arches (I.–VI. inclusive). These organs were potentially motor organs, as was shown by their powerful muscular apparatus and by the active flicking movements which they could perform; they were also potentially supporting structures, as was shown by the so-called "balancers," in which form the mandibular pair persisted in many Urodeles. He held that by far the simplest view of the origin of the paired limbs was that

they had developed out of a couple of the more posterior pairs of external gills, the girdles to which they were attached representing the skeleton of the corresponding branchial arches.

Mr. Kerr in the course of his paper controverted the view that the external gills were secondarily developed adaptive structures in the groups in which they occur; he also dealt with the difficulty that most true external gills contain no cartilaginous axis, pointing to the barbels of *Xenopus* with their cartilaginous axis, and to the rod of cartilage found by Budgett projecting into the base of the external gill of the hyoid arch of the young crossopterygian.

Tuesday afternoon's meeting of the Section opened with a lantern lecture by Major R. Ross on the story of malaria. He dealt in detail with the history of the various stages in the discovery and establishment of the mosquito theory, from the first fact, the discovery of the malarial pigment in 1849, to Manson's crucial experiment in 1900. He then passed to the prevention of malaria and other mosquito-borne diseases, and gave an account of the experiments now in progress in Sierra Leone and Lagos.

The session ended with three exhibitions—Dr. Francisco P. Moreno showing photographs of fossils in the La Plata Museum, Prof. Gilson a new sounding and ground-collecting apparatus, and Dr. J. Rankin a new orientating apparatus for the Cambridge microtome.

During the last few days of the meeting three of the zebra hybrids bred by Prof. Ewart were on view in the quadrangle (medical) adjoining the sectional meeting room. These hybrids were: (1) "Remus," the largest of the three, was born May, 1897, dam a 14-hands bay half-bred Irish pony. The mane of "Remus" was all but removed last April. (2) "Sir John," the small stout one, was born June, 1899. His dam is a yellow and white Iceland pony. "Sir John" probably reproduces fairly accurately the coloration of the primeval common ancestor of the horses and zebras. (3) "Birgus," the slender hybrid, was foaled May, 1900. His dam is a chestnut 14-hands polo pony. In 1898 this polo pony had twin hybrids, one of which goes extremely well and quietly in harness.

It is impossible to conclude even a brief account of the zoology of the meeting without at least a passing reference to the excellent volume on the natural history of Glasgow and the west of Scotland issued under the title "Fauna, Flora and Geology of the Clyde Area" as one of the three handbooks prepared by the local committee. A large number of specialists have collaborated in the production of the lists and articles, the result being a work of great completeness and of more than local interest, and of permanent value.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

THE work of Section E at the meeting at Glasgow maintained the feature which has been noticeable for the last two or three years; the number of "popular" papers was comparatively small, while papers presenting the results of detailed research, or laying down foundations of future work, formed a distinct majority. Although the change has led to a marked diminution in the average numbers attending the meetings of the Section, it must be regarded as satisfactory, inasmuch as it indicates an increase in the annual output of scientific work by geographers in this country, and the fact is all the more gratifying in view of the difficulties in the way of geographical research, to which Dr. Mill drew attention in his presidential address. Dr. Mill laid his finger upon the true reason why "the few attempts which have been made in this country to promote the study of geography or to diminish the discouragements to geographical research have had but slight success" when he pointed out that "amongst the not inconsiderable number of teachers of geography in the universities and colleges of Great Britain there is not one man who receives a salary on which he can live in decent comfort so as to devote all his time, or a substantial part of it, to geographical research; and the same is true of every official of all the geographical societies." Until there are properly equipped centres offering adequate opportunities for research as well as teaching, we cannot expect students of geography to receive the intellectual stimulus which research alone can give, nor can we develop a system of geographical teaching suited to our special educational

needs and methods, and capable of satisfactory extension to our schools.

Following the delivery of the president's address on Thursday morning, Mr. E. G. Ravenstein read a paper on Martin Behaim. Martin Behaim fills a place of some prominence in the history of geography on three grounds: firstly, the historian João de Barros, writing in 1539, states that he was a pupil of Regiomontanus, and was appointed a member of a committee which devised a method of "navigating by the sun"; secondly, Behaim claims to have commanded a vessel in Cão's second expedition; and thirdly, during a visit to Nürnberg in 1490-93, he superintended the manufacture of a terrestrial globe, which survives to this day. Mr. Ravenstein seriously doubts the first claim, rejects the second, and fully admits the third.

The tenth and final report of the Committee on the climate of Tropical Africa was also presented. In this report, drawn up by Mr. Ravenstein, abstracts of the meteorological observations received during the year are published, and a review is given of the work of the Committee since its first appointment in 1891. In completing its labours, the Committee recommends that where local provision is not made for the publication of observations, the registers should be forwarded in future (through the Foreign or Colonial Office) to the Meteorological Council or to the secretary of the Royal Meteorological Society. Copies of the "Hints to Observers," published by the Committee, may be obtained from the secretary of the Royal Meteorological Society.

Dr. A. J. Herbertson read a paper on the morphological divisions of Europe, in which he pointed out the inadequacy of the ordinary physical map for many of the purposes of the geographer. The paper was illustrated by a new "morphological" map of Europe, based primarily on the work of Suess, in which Europe was divided into physical regions, taking into account, not merely configuration, but composition and structure, and by a few well-chosen examples, such as the comparative structure of the south-east of England, the Seine basin, and the German Jura. Dr. Herbertson showed the undoubted value of maps of this type for purposes of both research and teaching.

The first paper in the afternoon was one by Mr. G. G. Chisholm, on geographical conditions affecting British trade. After illustrating his contention that geographical conditions, although often disregarded, were really important factors to be taken into account, by pointing out that Glasgow remained unimportant, both commercially and industrially, until the development of Transatlantic trade, Mr. Chisholm discussed the effects which improvements in means of communication, electric transmission of power, and other modern developments, are likely to produce in the trade of Great Britain as compared with that of other countries.

Prof. Alleyne Ireland read a paper on the influence of geographical environment on political evolution, in which he discussed the possibilities of native government within the tropics, concluding that while the natives of the tropics are not deficient in intellectual power, their "climatic discipline" renders them unfitted to play the part of legislators or responsible administrators or to maintain a government sufficiently stable to admit of proper commercial development.

The Rev. Thomas Lewis gave an account of journeys in Portuguese Congo, in the course of which he has collected much valuable topographical information.

Friday morning was devoted to the geography of Scotland, and the proceedings afforded gratifying evidence that in spite of difficulties Scottish geographers are prosecuting research along various lines with vigour and success.

The first paper was one by Prof. G. F. Scott Elliot, on the effects of vegetation in the Valley and Plain of the Clyde. The general characters of the Clyde Valley in seven separate divisions were described—the sub-alpine, heather and peat, sheep pasture and arable districts; the Falls of Clyde canyon, the valley below the falls, and the flat and alluvial plains—and the successive stages in the formation of the valley slope were traced in a number of instances. It was shown that a perfect series of transitions can be found from the vertical scarp cut by the river to the continuous steep slope characteristic of the neighbourhood, and that the formation of the slope, in its various stages, was controlled by the vegetation.

Miss Marion Newbigin gave an account of a scheme which has been undertaken by the Scottish Natural History Society at the suggestion of Sir John Murray. It is proposed, firstly, to arrange, in a readily available form, references to papers already